“Digital strategies and consumer engagement in fashion livestream commerce: A cross-market analysis”

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DIGITAL STRATEGIES AND CONSUMER ENGAGEMENT IN FASHION LIVESTREAM COMMERCE: A CROSS-MARKET ANALYSIS

Abstract

Livestream commerce has become an increasingly important channel in digital fashion retail because it integrates entertainment, interaction, and real-time purchasing within a single shopping environment. This study aimed to examine how four digital marketing strategy elements — presenter type, layout design, interactivity features, and call-to-action timing — affect consumer engagement, interactivity, and purchase behavior in fashion livestream commerce across the Gulf region (the United Arab Emirates and Saudi Arabia) and Singapore. The study used a contextual multi-armed bandit design across 25 live fashion sessions, generating more than 12,000 usable impressions from approximately 1,500 unique viewers, and estimated causal effects using doubly robust estimation with session-clustered inference. The results show that influencer- or celebrity-led sessions increased engagement by 0.9 minutes relative to staff-led sessions and improved purchase consideration by 0.5 points. Dynamic overlay layouts increased interactivity by 6.5 actions, while interactive features raised add-to-bag outcomes by 3.4 percentage points. Mid-stream call-to-action placement outperformed early and late placement, improving add-to-bag outcomes by approximately 4-5 percentage points. Mediation analysis further showed a significant indirect effect of engagement on add-to-bag through interactivity of 1.2 percentage points. Cross-market comparisons revealed that presenter effects were stronger in the Gulf, whereas layout and timing effects were stronger in Singapore. The findings conclude that effective livestream commerce performance depends on the alignment of presenter credibility, interface design, interactivity, and action timing within specific market contexts.

Keywords livestream, fashion, engagement, marketing, Gulf, Singapore

JEL Classification M31, L81, C44, O33

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INTRODUCTION

Livestream commerce is revolutionizing digital fashion retail because it combines entertainment, social interaction, and purchasing within a single platform. For fashion retailers, it is a key platform because achieving competitive advantage depends on being able to attract, retain, and convert consumer interest into action within a live stream. Consumers may browse a range of products by watching a presenter use a product, ask questions, and react to various on-screen prompts, with the ability to make a purchase without leaving the stream. For digitized markets such as the Gulf Cooperation Council and Singapore, it is a key platform because it could accelerate consumer adoption and raise competitive stakes.

The key scientific problem, therefore, lies in the fact that the rules of behavior that determine the effectiveness of livestreams have not yet been defined in a way that is both explanatory and transferable across markets. Several digital levers are open to adjustment, including the

presenter's identity and credibility, the layout and overlays, interactive elements, and the timing of calls-to-action, and yet the precise levers that are important, the nature of their interactions, and their context-dependent and invariant effects on engagement and purchase remain unclear. A single design element can both engage and overload, and a single presenter cue can both improve and fail to compensate for interface clarity, depending on the context. Without a comprehensive model of the underlying mechanisms and their interactions, strategy transfer becomes guesswork, and features are optimized that may not ultimately contribute to commercial success.

The problem is further complicated by the dynamic nature of the behavior that underlies livestream outcomes. The outcomes are a product of a rapid sequence of micro-decisions, in which attention waxes and wanes minute by minute, interactions can either augment or undermine persuasion, and purchase decisions are triggered by a dynamic combination of motivation, information clarity, and interface convenience. Therefore, in order to understand fashion livestream commerce, explanations must account for the dynamic nature of the outcomes, rather than assuming static and context-free effects.

1. LITERATURE REVIEW AND HYPOTHESES

Livestream commerce has developed as a retail format that combines entertainment, real-time interaction, and transaction execution within the same digital environment. In fashion retail, this format is especially relevant because consumer evaluation depends not only on product information but also on aesthetic presentation, presenter credibility, and the speed of communication (Ma et al., 2025; Wang et al., 2024). Existing research shows that livestream shopping can make purchasing more immersive and interactive by strengthening trust and emotional connection in ways that conventional online shopping often cannot achieve (Askarizad et al., 2024; Picot-Coupey et al., 2023). More broadly, previous studies generally report that livestream commerce improves social presence, reduces product uncertainty, and strengthens purchase intention (Ju et al., 2025; Sharma et al., 2024).

At the same time, the prior scientific landscape remains regionally concentrated. Most empirical evidence has been generated in China, where livestream shopping operates within relatively closed digital ecosystems that combine influencer promotion, recommendation systems, and payment functions within the same platform structure (Liu & Liang, 2025; Wang, 2025). This literature has made an important contribution to understanding livestream commerce, but its findings cannot automatically be generalized across markets with different consumer cultures, platform structures, and technological conditions. Recent studies therefore highlight the need to extend empirical work beyond East Asia and to examine contexts such as the Gulf Cooperation Council states and Singapore more directly (Liang et al., 2025; Suvittawat et al., 2025).

The emerging evidence from these settings indicates that livestream commerce operates differently across markets. In the GCC, especially in the United Arab Emirates and Saudi Arabia, livestream shopping is embedded in a mobile-first and influencer-oriented retail environment in which presenter trust and credibility are central to engagement and purchase response (Abdulla & Saberi, 2025; Edwards et al., 2025). In Singapore, by contrast, the market is more digitally mature and appears to place greater emphasis on gamification, interface efficiency, and design optimization (Konale et al., 2025; Lim et al., 2025). These differences suggest that livestream marketing performance depends on the degree of alignment among cultural expectations, technological infrastructure, and marketing design (Foong et al., 2024; Zafar et al., 2025).

Within this broader landscape, consumer engagement has emerged as one of the most important explanatory constructs. Engagement reflects both emotional and behavioral involvement and is therefore highly relevant to livestream settings that rely on attention, participation, and continuity of response (Malik & Pradhan, 2025). Higher engagement is consistently associated with stronger purchase intention and loyalty outcomes.

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However, the literature also shows that the drivers of engagement are not identical across countries. In China, parasocial interaction and social presence are often emphasized (Cayolla et al., 2024). In GCC markets, authenticity and aspiration linked to influencers are more visible drivers (Abdulla & Saberi, 2025). In Singapore, gamification and interface quality appear more central (Luo et al., 2025). Accordingly, engagement should be understood not as a universal mechanism with identical antecedents, but as a market-contingent process shaped by culture and technology.

The literature also reveals an important methodological pattern. Most studies use cross-sectional designs or structural equation modeling, which are useful for identifying associations but less effective in capturing the dynamic and rapidly changing nature of livestream sessions (Guo et al., 2024; Irfan & Bryła, 2025). Yet livestream commerce is inherently dynamic because consumer response can shift from moment to moment depending on presenter cues, layout changes, interaction tools, and message timing (Morshed et al., 2024). In related marketing research, adaptive decision models such as multi-armed bandit algorithms have shown strong potential because they balance exploration and exploitation when testing alternative strategies in real time (Tajik et al., 2024). Despite this potential, such designs remain underused in livestream commerce research.

A related line of research shows that technological advancement has changed the way consumers interact with livestream commerce, but adoption patterns differ across markets (Ali & Morshed, 2024; Salhab et al., 2025). In China, technological features are commonly embedded in platform infrastructure, whereas in the GCC they are more often incorporated into influencer-led smart retail strategies, and in Singapore they are frequently expressed through gamification and incentive-based digital design (Rai et al., 2024; Serôdio et al., 2024; Elhajjar, 2025). Differences are also visible in the data and methods used across regions. Chinese studies more often rely on behavioral and transactional data, whereas GCC studies tend to emphasize perceptual and attitudinal measures (Hartmann et al., 2025; Hung et al., 2024). This divergence limits cross-market comparability and contributes to the fragmented character of the field.

The theoretical landscape is similarly diverse. Existing studies draw on several complementary perspectives to explain livestream commerce outcomes (Lin & Lee, 2024). Source Credibility Theory and Parasocial Interaction Theory explain how presenter authenticity, familiarity, and trust shape persuasion in livestream environments (Tran et al., 2024). Cognitive Load Theory and Signaling Theory explain why layout design and visual organization influence information processing and consumer response (Chen et al., 2024; Iliska & Gudoniene, 2025). Self-Determination Theory and Commitment Theory clarify why interactive mechanisms can strengthen motivation, involvement, and purchase intention (Meng, 2024; Orji et al., 2025). The Elaboration Likelihood Model and Fogg's Behavior Model further suggest that the timing of persuasive prompts matters because it affects readiness, attention, and behavioral activation (Grant, 2024; Jiang et al., 2024). Although these perspectives are individually useful, prior research rarely integrates them into a single model that jointly explains human, technological, and situational drivers of livestream commerce outcomes (Morshed, 2025b).

The behavioral sequence studied in livestream commerce also remains insufficiently specified. Consumer response can be viewed as a progression from attention to interaction and then to action, which is consistent with hierarchy-of-effects reasoning and flow-based interpretations of digital consumer behavior (Al-Daoud & Abu-AlSondos, 2025). However, many studies report aggregate outcomes and pay limited attention to mediation pathways between engagement, interactivity, and purchase-related behavior (Bolun et al., 2025). Previous findings are also mixed regarding the independent and combined effects of presenter type, layout design, interactivity features, and CTA timing (Hemsley-Brown, 2023). These elements may reinforce one another, but they may also create overload or conflict. Cognitive Load Theory suggests that multiple simultaneous cues may overburden consumers, whereas Multimedia Learning Theory suggests that aligned cues may generate additive benefits when they are well coordinated (Singh et al., 2024).

Cross-cultural and consumer-readiness differences add another important layer. Market context shapes how consumers interpret persuasion, interface cues, and interactivity elements (Konale

et al., 2025). In Gulf markets, engagement is more closely associated with social aspiration and influencer credibility, while in Singapore it is more closely associated with efficiency and interface optimization (Konale et al., 2025). Consumer readiness also matters because prior livestream shopping experience and familiarity with the device or application can influence responsiveness to livestream marketing stimuli. Existing evidence suggests that app-based users and repeat viewers are more responsive than web users and first-time viewers (Abdulla & Saberi, 2025).

Overall, prior research shows that livestream commerce can strengthen engagement, interactivity, and purchase-related outcomes, but the evidence remains fragmented across markets, theories, and methods. The literature does not yet provide a sufficiently integrated explanation of how presenter type, layout design, interactivity features, and CTA timing operate separately and jointly across different market settings. As a result, the current scientific landscape supports the importance of livestream commerce, but it does not yet offer a coherent and generalizable framework for explaining cross-market variation in fashion livestream performance.

Accordingly, the purpose of this study is to examine how four digital marketing strategy elements, namely presenter type, layout design, interactivity features, and call-to-action timing, influence consumer engagement, interactivity, and purchase behavior in fashion livestream commerce in the Gulf region, specifically the United Arab Emirates and Saudi Arabia, and Singapore. The conceptual model proposes that these four marketing levers affect behavioral outcomes directly and indirectly through engagement and interactivity, while also varying by market context and consumer readiness.

Study hypotheses are as follows (Figure 1):

H1: Influencer- or celebrity-led streams yield higher engagement and purchase consideration than staff-led streams.

H2: Dynamic overlay layouts increase interactivity without reducing engagement.

H3: Interactive streams generate higher add-to-bag and purchase consideration rates than non-interactive ones.

H4: Mid-stream call-to-action placements outperform early or late CTAs in driving purchase behavior.

H5: Presenter effects (H1) are stronger in the Gulf region, while layout and timing effects (H2-H4) are stronger in Singapore.

H6: The effects of H1-H4 are greater for app users and repeat viewers than for web users and first-time viewers.

H7: Engagement and interactivity mediate the effects of presenter, layout, interactivity, and CTA timing on purchase behavior.

H8: Presenter credibility and overlay design interact positively to enhance interactivity and add-to-bag outcomes.

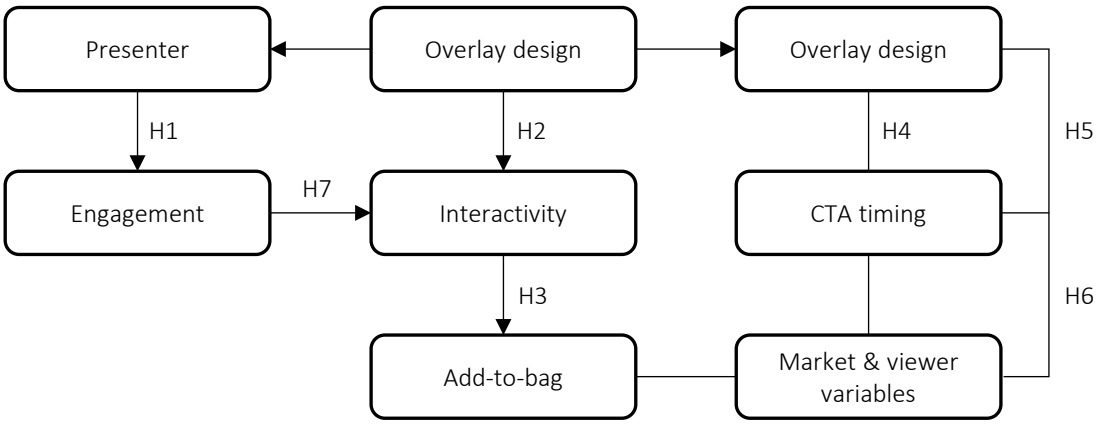

Figure 1. Conceptual framework

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2. METHODOLOGY

This study follows an online field experimental procedure embedded in real-time fashion livestream sessions to examine how marketing interventions influence consumer engagement and purchase behavior. The unit of analysis is one viewer's exposure to a specific treatment condition during a livestream event. The experimental process involved a series of connected steps, which integrated aspects of random assignment and adaptive learning, while at the same time protecting causal identification.

The countries targeted by the study include the United Arab Emirates, Saudi Arabia, and Singapore. The markets chosen for study were chosen because they represent contrasts within a generally digital and highly developed marketplace. For instance, within the Gulf states, there is a tendency towards a mobile-first consumer culture that is augmented by a strong tradition of shopping culture that is heavily influenced by social media personalities and influencers. In Singapore, there is a more integrated and systematically optimized approach to shopping culture that is more multi-platform and diverse (Theodorakopoulos et al., 2025). For empirical study, the context was defined by twenty-five commercial fashion livestream sessions on interactive platforms that can support live video streams, chat-based communication, and purchasing within a stream. For exposure, organic exposure was supplemented by a balanced panel component to maximize viewer diversity. Overall, there were around 1,500 unique viewers and over 12,000 usable impressions at a usable level.

Data generation involved a contextual multi-armed bandit approach. In the first phase, a warm-start randomization strategy was used. In the second phase, the strategy changed in real-time, depending on engagement and shopping behavior. In the third phase, exploitation was emphasized, with a greater proportion of impressions being directed towards the best-performing strategies, while a non-zero proportion was reserved for all alternative strategies, as a way of ensuring exploration and identification (C. Wang et al., 2025). Each impression was recorded, including the treatment, contextual information, and outcome variables, in order to ensure full traceability.

The experimental manipulations involved four strategic dimensions: presenter, layout, interactivity, and call-to-action (CTA) timing. The presenter condition involved differences between celebrities, influencers, and staff, and was used as a credibility signal. Layout involved differences between a minimalist and dynamic overlay approach. Interactivity involved turning features on and off, while call-to-action timing involved differences in terms of whether the call-to-action was in the early, mid, or late part of the livestream timeline (Manca et al., 2025).

The basic analytical data set combined three data streams to create a complete picture: platform click stream data that records users' navigation patterns, live stream event logs that track interactions in real-time, and micro-survey data that records users' feedback after viewing posts. User engagement was operationalized as normalized dwell time, whereas interactivity was operationalized as the overall number of chat posts or taps for users (Ahmad et al., 2023). Finally, purchase-oriented behavior was operationalized as add-to-bag rate, which is the ratio of clicks with buying intent. Consideration was operationalized as the mean product interest score based on a five-point rating scale. Furthermore, a series of context covariates were included as secondary inputs to enable the model to account for heterogeneity in terms of why responses are affected across different contexts (Al-Muntasir, 2022). The data streams were carefully synchronized so that exposure, context, and behavior are precisely aligned at the impression level (Tokuç & Dağ, 2025).

Table 1. Study design: treatment factors, conditions, and data sources

Dimension	Levels	Measurement source
Presenter identity	Celebrity / Influencer / Staff	Session metadata
Layout design	Minimalist / Dynamic overlays	Creative template logs
Interactivity	With / Without polls or prompts	Platform event logs
CTA placement	Early / Mid / Late	Session timeline
Primary outcomes	Engagement / Interactivity / Add-to-bag / Consideration	Clickstream and micro-survey data

Preprocessing and quality assurance were performed in an organized, completely reproducible manner. Automated filters were used to exclude bot effects, multiple impressions, and sessions affected by factors like ad blockers or latency-induced interruptions. Assumptions of missing completely at random and missing at random were used to evaluate missing data patterns. In some cases, inverse probability weighting was also employed to correct for bias due to non-random missing data (Morshed, 2024). Every step in preprocessing and data cleaning was logged to ensure that the data could be reconstructed in an entirely reproducible manner without any human intervention (Hemmatpour et al., 2024).

The basis of causal identification in contextual bandits relies on three fundamental conditions: consistency, sequential ignorability, and overlap. The conditions are met using a randomized warm start, contextual covariate measurement, and the avoidance of any dominant treatment in the contextual bandit design. The policy function $\pi(a|x)$ is applied in the contextual bandit to specify the conditional probabilities of the treatment assignment given the context, thus facilitating the calculation of the expected outcomes $E[Y|X,A]$ of all the available treatment options (Oreqat, 2021). These outcomes were continuously updated with the accumulation of new data using the learning algorithm. Session identifiers were used as clustering units for subsequent estimation, accounting for within-event correlations (Morshed, 2026). The algorithms used for analysis were preregistered, and all code used was documented with fixed random seeds (Cai et al., 2024).

Data were collected in August and September 2025, collecting data from 25 live fashion livestreams conducted in the United Arab Emirates, Saudi Arabia, and Singapore. The data collection window was chosen to ensure a stable volume of platform traffic and a similar promotional environment. The data collected consist of around 1,500 unique viewers and >12,000 impression-level data points. A small micro-survey was conducted after a viewer viewed a piece of content, measuring consideration using a five-point scale. The micro-survey was kept brief in order not to interfere with the viewer's experience and was conducted in a way that allows data collected across markets to be interpreted in a similar way. The full questionnaire can be viewed in Zenodo and cited in the article using a DOI (DOI: 10.5281/zenodo.18514756). In accordance with publication ethics, the data collected in this study (and the results) cannot be used as a basis for two or more publications, as this data was collected specifically for this publication and has not been used as the primary data source for any publication prior to this. Impartiality was ensured by using an algorithm in the serving system that randomly assigned the treatment, without any discretion on the part of the researcher. Viewers received on-screen disclosure and provided informed digital consent; participants could withdraw via in-app privacy controls or the platform Help/Support function. All personal identifiers were removed prior to storage, and only de-identified variables required for estimation were retained under platform privacy requirements and restricted access. The Research Ethics Committee/IRB at Middle East University approved the protocol on 22 April 2025 (Approval No. MEU-REC-22APR2025-01). Implementation operated under <100 ms latency, with versioned decision logs linking policy parameters, context, and outcomes. Logged-policy performance was estimated using inverse-propensity, self-normalized, and doubly robust estimators to ensure auditable, probability-corrected inference.

3. RESULTS

The experiment yielded a complete record of viewer behavior across twenty-five fashion livestream events and more than twelve thousand impressions, enabling analysis, systematization, and calculation of effects for all predefined outcomes. Table 2 presents the market composition and audience profile: the Gulf region (United Arab Emirates, Saudi Arabia) accounted for 61% of impressions and Singapore for 39%. Gender distribution was balanced (54% female, 46% male). Mobile access dominated (83%), and 58% of impressions came from returning viewers, indicating habitual participation (Johnson et al., 2025).

Descriptive calculations for the four primary variables appear in Table 3. Mean engagement (dwell time) was 3.8 minutes (SD = 1.2; min = 0.5; max = 9.1). Interactivity averaged 12.4 actions per viewer

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Table 2. Sample profile by market, device use, and repeat-viewing status

Market	Viewers (n)	Impressions (%)	Female (%)	Mobile users (%)	Returning viewers (%)
UAE	420	28	55	85	60
Saudi Arabia	500	33	52	82	58
Singapore	580	39	53	83	55
Total	1,500	100	54	83	58

Table 3. Descriptive statistics of the main engagement, interactivity, and purchase outcomes

Outcome variable	Mean	SD	Min	Max
Engagement (minutes)	3.8	1.2	0.5	9.1
Interactivity (actions)	12.4	5.3	0	41
Add-to-bag rate (%)	9.0	3.1	0.5	18
Consideration (1–5)	3.7	0.9	1	5

(SD = 5.3; min = 0; max = 41). The add-to-bag rate averaged 9.0% (SD = 3.1; min = 0.5; max = 18), and mean product consideration was 3.7 on a 1-5 scale (SD = 0.9). These distributions confirm adequate variance for treatment-effect estimation.

Aggregate condition means are reported in Table 4. Influencer- and celebrity-led streams outperformed staff-led sessions on engagement (4.2 and 4.0 vs. 3.3 minutes) and on consideration (3.9–4.0 vs. 3.4). Dynamic overlays increased interactivity (15.8 vs. 9.3 actions) with a small lift in add-to-bag (9.2% vs. 8.4%). Interactivity features (polls/prompts) improved both engagement (4.1 vs. 3.5 minutes) and add-to-bag (10.6% vs. 7.2%). Mid-stream calls to action produced the highest conversion (12.0%) relative to early (8.0%) and late (7.0%) placement (Barrett & Gómez, 2025).

Systematized differences versus baseline conditions are shown in Table 5. Influencer vs. staff produced Δ engagement = +0.9 minutes, Δ interactivity = +4.4 actions, Δ add-to-bag = +3.0 pp, and Δ consideration = +0.5 points. Celebrity vs. staff produced similar positive deltas. Dynamic vs. minimalist layout yielded Δ interactivity = +6.5 actions with small gains elsewhere (Taqa, 2025). Interactivity features raised add-to-bag by +3.4 pp. Mid-stream vs. early CTA increased add-to-bag by +4.0 pp; mid-stream vs. late by +5.0 pp (Xiao et al., 2024).

The pre-registered hypotheses H1-H8 were evaluated using session-clustered inference and, where applicable, mediation models. Table 6 summarizes direct-effect conclusions: H1 (presenter credibility) supported; H2 (dynamic layout increases interactivity without reducing engagement) supported; H3 (interactivity features increase add-to-bag) supported; H4 (mid-stream CTA outperforms early/late) supported; H5 (cross-market moderation) partially supported; H6 (stronger effects for app users and repeat viewers) supported; H7 (sequential mediation) supported; H8 (presenter × overlay complementarity) supported.

Table 4. Mean engagement, interactivity, add-to-bag, and consideration outcomes by experimental condition

Factor	Levels	Engagement (mins)	Interactivity (actions)	Add-to-bag (%)	Consideration (1–5)
Presenter	Celebrity	4.0	13.5	9.5	4.0
	Influencer	4.2	14.2	10.0	3.9
	Staff	3.3	9.8	7.0	3.4
Layout	Minimalist	3.6	9.3	8.4	3.6
	Dynamic overlay	4.1	15.8	9.2	3.8
Interactivity	With features	4.1	14.9	10.6	3.9
	Without features	3.5	8.7	7.2	3.5
CTA timing	Early	3.7	12.0	8.0	3.6
	Mid-stream	4.2	14.7	12.0	4.0
	Late	3.5	10.2	7.0	3.5

Table 5. Estimated treatment effects relative to baseline conditions across the main study outcomes

Factor	Comparison	Δ engagement	Δ interactivity	Δ add-to-bag	Δ consideration
Presenter	Influencer vs. Staff	+0.9	+4.4	+3.0	+0.5
	Celebrity vs. Staff	+0.7	+3.7	+2.5	+0.6
Layout	Dynamic vs. Minimalist	+0.5	+6.5	+0.8	+0.2
Interactivity	With vs. Without	+0.6	+6.2	+3.4	+0.4
CTA timing	Mid vs. Early	+0.5	+2.7	+4.0	+0.4
	Mid vs. Late	+0.7	+4.5	+5.0	+0.5

Table 6. Summary of hypothesis test results for the direct, moderated, and mediated effects

Hypothesis	Statement	Supported?	Evidence
H1	Influencer/celebrity > staff	Yes	+0.9 min engagement, +0.5 consideration
H2	Dynamic > minimalist layout	Yes	+6.5 interactivity actions
H3	Interactivity increases add-to-bag	Yes	+3.4 pp
H4	Mid-stream CTA > early/late	Yes	+4–5 pp
H5	Presenter stronger in Gulf; design/timing stronger in Singapore	Partial	Significant regional contrasts
H6	App users and repeat viewers more responsive	Yes	Consistent higher effects
H7	Engagement → interactivity → action (mediation)	Yes	Significant indirect paths
H8	Presenter × overlay interaction	Yes	Super-additive effects

Mediation calculations in Table 7 show a significant indirect effect of engagement on add-to-bag via interactivity of +1.2 percentage points (95% CI: [0.4, 2.0], $p < 0.05$). Engagement also increased consideration indirectly by +0.3 points (95% CI: [0.1, 0.6], $p < 0.05$). These results verify the sequential pathway (attention → participation → action) and formally support H7 (Dai, 2025).

Cross-market systematization in Table 8 demonstrates that presenter effects are stronger in the Gulf, whereas layout and timing effects dominate in Singapore. For example, influencer vs. staff raised dwell time by +0.95 minutes in the Gulf versus +0.45 in Singapore. Dynamic overlays increased interactivity by +7.1 actions in Singapore (vs. +5.2 in the Gulf), and mid-stream CTAs lifted add-to-bag by +5.3 pp in Singapore (vs. +3.7 pp in the Gulf). These calculations confirm the market-specific structure of treatment responsiveness and partially support H5 (Bulut, 2025).

Heterogeneity analyses in Table 9 indicate that mobile users and repeat viewers are systematically more responsive. With dynamic overlays, mobile users showed +3.2 pp higher add-to-bag than desktop users. Interactivity features increased add-to-bag by +4.1 pp for returning viewers versus +2.3 pp for first-timers. Apparel outcomes were more sensitive to presenter credibility (consideration +0.5 points), whereas accessories responded more to timing (mid-stream CTA +3.8 pp), supporting H6 and clarifying product-level mechanisms (Lipkovich et al., 2024).

Table 7. Indirect effects of engagement on purchase-related outcomes through interactivity

Pathway	Indirect effect	95% CI	Significance
Engagement → Interactivity → Add-to-bag	+1.2 pp	[0.4, 2.0]	$p < 0.05$
Engagement → Interactivity → Consideration	+0.3 pts	[0.1, 0.6]	$p < 0.05$

Table 8. Cross-market comparison of treatment effects in the Gulf region and Singapore

Factor	Outcome	Gulf (UAE & KSA)	Singapore	Key contrast
Presenter	Dwell time (mins)	+0.95 vs. staff	+0.45	Stronger in Gulf
Presenter	Consideration (1–5)	+0.6 vs. staff	+0.3	Stronger in Gulf
Layout	Interactivity (actions)	+5.2 vs. minimal	+7.1	Stronger in Singapore
CTA timing	Add-to-bag (%)	+3.7	+5.3	Stronger in Singapore
Interactivity	Add-to-bag (%)	+3.0	+3.6	Similar effect

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Table 9. Heterogeneous treatment effects by viewer segment and product category

Subgroup factor	Condition	Key outcome	Effect size (Δ)	Interpretation
Device type	Mobile vs. desktop	Add-to-bag with overlays	+3.2 pp	Mobile users more responsive
Viewer status	Returning vs. first-time	Add-to-bag with interactivity	+4.1 vs. +2.3 pp	Familiarity amplifies effect
Product category	Apparel vs. accessories	Consideration (presenters)	Apparel +0.5	Trust matters more for apparel
Product category	Accessories	Add-to-bag with mid CTAs	+3.8 pp	Timing drives low-involvement items

Robustness checks in Table 10 confirm that the calculated effects are stable across specifications and time. Session-clustered inference preserved significance at $p < 0.05$. Placebo tests on pre-treatment scrolling produced no associations. Propensity truncation (5th-95th percentiles) widened intervals slightly without altering conclusions (Morshed, 2025a)

Estimates were consistent across linear, boosted, and shallow neural learners, and no temporal drift was detected across event phases. These diagnostics validate the integrity of the analysis and support the reliability of the reported effects (Elmaghrabi & Diab, 2024).

The results of the analysis indicate that there is substantial empirical support for *H1*, *H2*, *H3*, *H4*, *H6*, *H7*, and *H8*, while *H5* was partially supported. The influencer and celebrity presenters were effective in generating consideration and engagement (*H1*), the dynamic layouts were effective in generating interactivity (*H2*), the use of interactive elements was effective in generating purchase rates (*H3*), and mid-stream CTAs were most effective in generating conversions (*H4*). There were also differences in the effects of presenters in the Gulf and layouts and timing in Singapore (*H5*). App users and viewers were more responsive (*H6*), the effects of engagement were sequential through interactivity (*H7*), and the interaction of presenters and overlay was effective in generating results (*H8*).

4. DISCUSSION

The results imply that livestream performance is a function of a synergistic interplay between credibility factors, interface factors, and timing, rather than being driven by any one key factor. In terms of presenter types, influencers and celebrity presenters generated higher engagement and purchase consideration than staff presenters. This is consistent with previous studies that have linked social credibility and parasocial trust effects with consumer responses to livestreams (Edwards et al., 2025). Nevertheless, the effect size is smaller than what many perception-related studies have indicated. This suggests that, although presenter credibility is useful in driving attention, it is not a replacement for effective interaction design. Unlike previous literature that suggests influencer presence is a key driver of conversion, the current results position influencer credibility as a necessary component with limited effect size.

The use of dynamic overlay layout designs significantly increased interactivity, supporting previous results that visually actionable elements drive interactivity (Hemsley-Brown, 2023). Nevertheless, its impact on driving purchases is smaller than expected. In particular, it adds a degree of nuance to previous literature that suggests that more complex visual environments drive higher sales. In reality, it suggests that visual complexity is more likely to activate behavioral responses than actual purchases. This is consistent with cognitive load and multime-

Table 10. Robustness and sensitivity checks for the main empirical results

Test type	Approach	Key result	Interpretation
Cluster-robust SEs	Session-level clustering	Significant at $p < 0.05$	Controls intra-session correlation
Placebo outcomes	Pre-treatment scrolling	No significant effects	Rules out spurious links
Propensity truncation	5th-95th percentiles	Wider CIs, same inference	Ensures overlap validity
Base learner comparison	Linear vs. boosted vs. neural	Convergent estimates	Model-spec stability
Drift analysis	Event-phase subsamples	No systematic decline	Temporal stability

dia learning theories that suggest that well-aligned cues may drive participation, although persuasion is not guaranteed (Singh et al., 2024).

The consistency of the call-to-action effect in all markets represents a unique level of field-level verification of persuasion timing theory. Although previous research provided the theoretical foundation for interventions occurring at moments of peak motivational readiness, few studies have provided empirical verification. The present results confirm these predictions and extend them to suggest that the effect of timing is relatively invariant even as culture is varied (Grant, 2024). Most importantly, the mediation results help to clarify the role of engagement. As engagement was not sufficient to produce purchase consideration on its own but was required to produce interactivity, these results support hierarchy of effects or flow models of livestream behavior as a process (Bolun et al., 2025; Sharma et al., 2024). Prior research had considered engagement and purchase as separate outcomes. The present results reconcile these views by showing that they are related stages in a behavioral chain. Finally, the adaptive experimental design addresses the need for dynamic causal modeling in livestream research. This approach is more valuable than static survey research for demonstrating the utility of real-time experimentation as a research approach (Tajik et al., 2024).

CONCLUSION

The purpose of this study was to examine how presenter type, layout design, interactivity features, and call-to-action timing influence consumer engagement, interactivity, and purchase behavior in fashion livestream commerce across the Gulf region and Singapore.

The results show that livestream commerce performance is shaped by a sequential behavioral process rather than by a single isolated marketing stimulus. Presenter credibility primarily strengthened attention and purchase consideration, dynamic overlay layouts increased interactivity, interactive features improved add-to-bag behavior, and mid-stream call-to-action placement generated the strongest conversion outcomes. The findings also reveal cross-market variation, as presenter effects were stronger in the Gulf context, whereas layout and timing effects were stronger in Singapore.

These results lead to the conclusion that effective livestream commerce strategy depends on the alignment of human persuasion, interface design, and action timing rather than reliance on any single marketing element. The findings further indicate that engagement should be understood as an activating mechanism that connects marketing stimuli with interactive and purchase-related outcomes. Finally, the study shows that livestream commerce optimization is context-dependent, meaning that strategies effective in one market cannot be assumed to produce the same results in another without adaptation to cultural and technological conditions.

AUTHOR CONTRIBUTIONS

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